Enabling Mobile Wireless Data with 3G CDMA

June 2004

Launchpad Applications

BREWapi

BREW Distribution System

gpsOne

CDMA Chipsets

Homeland Security Initiatives

Fleet Management Solutions

CDMA2000 1X

CDMA2000 1xEV-DO

CDMA2000 1xEV-DV

WCDMA/UMTS

Application Solutions

Mobile Processors

Base Station Processors

Radio Processors

CDMA University

Network Optimization

Software Tools

Development Tools

QCTest Tools

Client Software

Digital Cinema

Advanced Security Solutions

Australia • Austria • Belarus • Brazil • Canada • Chile • China • Colombia • Denmark • Dominican Republic • Ecuador • Guatemala • India • Indonesia • Israel • Italy • Japan • Mexico
• Moldova • New Zealand • Nicaragua • Panama • Romania • Russia • South Korea • Sweden • Taiwan • Thailand • United Kingdom • United States • Venezuela • Vietnam

QUALCOMM CDMA Technologies

QUALCOMM Technology Licensing

QUALCOMM Wireless and Internet Group

QUALCOMM Strategic Initiatives

Overview of Key Wireless Terms

- **WWAN:** Wireless Wide Area Network
  - Category of technology deployed by cellular operators such as Verizon Wireless
- **1G:** or '1st-Generation', analog cellular (includes AMPS in the U.S.)
- **2G:** or '2nd-Generation', digital cellular (includes cdmaOne, GSM and TDMA technologies)
  - Primarily voice, 9.6 to14.4 kbps circuit switched data, better capacity than analog
- **3G:** or '3rd-Generation', more capacity for voice and high-speed data
  - Requirements: 144 kbps mobile, 384 kbps pedestrian, and/or 2 Mbps fixed environments*
- **CDMA2000®:** Family of 3G technologies including:
  - **1X:** Efficient 3G voice and data upgrade for CDMA operators. Delivers typical packet data rates from 50 – 90 kbps, peak rates of 153 kbps. Providing service today to over 96.8 million reported subscribers worldwide**
  - **1X Rev D (EV-DV):** Simultaneous voice/data with peak rates 3.1 Mbps on the forward link and 1.8 Mbps on the reverse link
  - **1xEV-DO:** Optimized for high-speed wireless data. Provides 2.4 Mbps peak rates and typical rates in the hundreds of kbps. Used by over 6.7 million reported subscribers in Korea and other countries**
  - **1xEV-DO Rev A:** Higher data rates - 3.1 Mbps on the forward link and 1.8 Mbps on the reverse link
- **WCDMA:** 3G technology based on CDMA and designed as an upgrade for GSM carriers or others obtaining new spectrum. Delivers and transmits data at peak speeds of 384 kbps.
- **HSDPA:** (High Speed Downlink Packet Access) Release 5 of the WCDMA standard providing peak rates up to 14.4 Mbps on the forward link
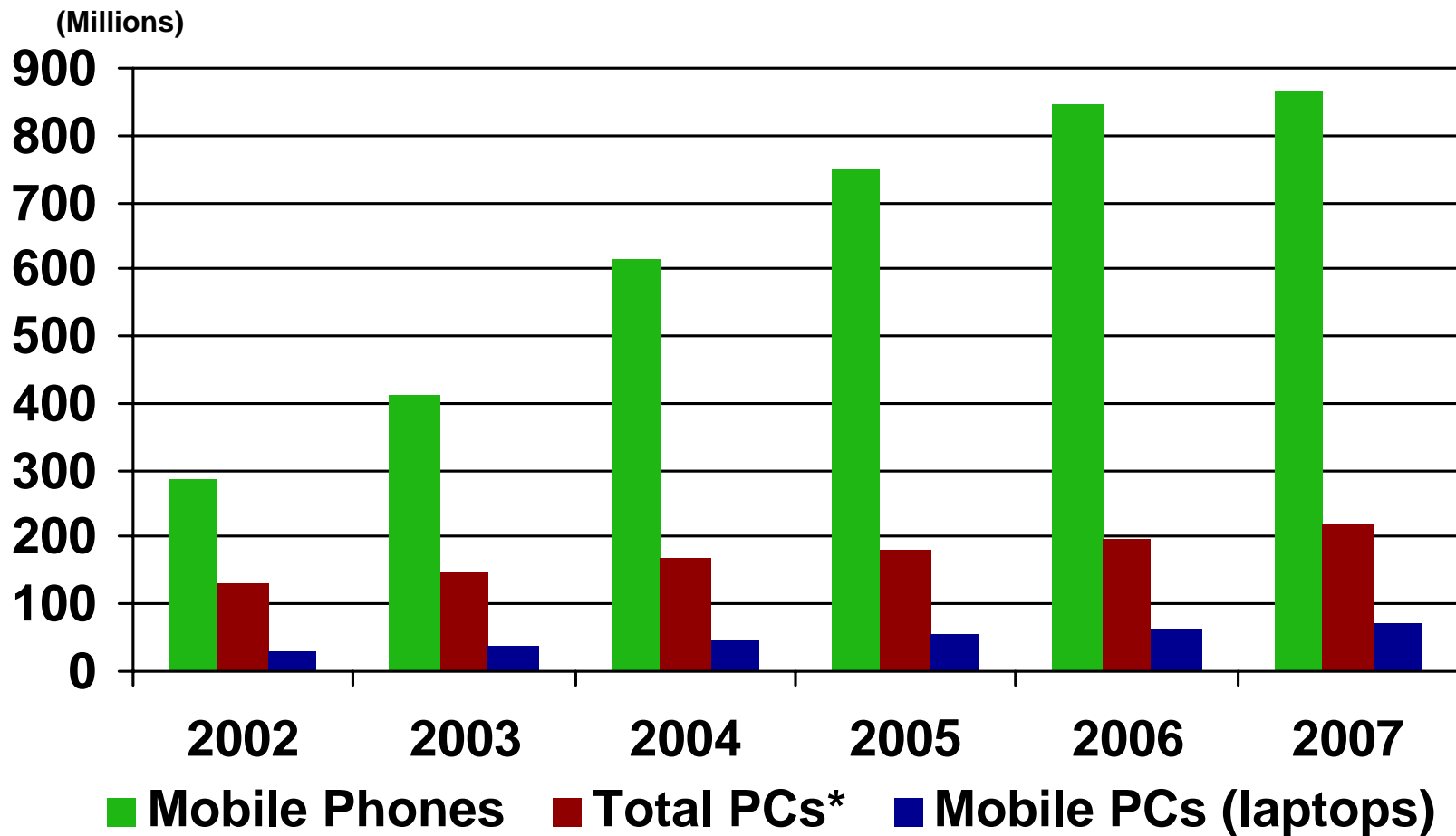- All these wireless technologies operate in **licensed** spectrum

Overview of Key Wireless Terms

- **WLAN:** Wireless Local Area Network
  - Category of cordless technologies for home/office cordless networking, now extended to public "hot spot" offerings
  - Common WLAN terms include Wi-Fi and 802.11

- **Wi-Fi:** or 'Wireless Fidelity', a popular name for 802.11 technologies that have passed Wi-Fi interoperability certification testing*

- **802.11:** or IEEE 802.11, is a family of WLAN networking technologies standardized by the IEEE (Institute of Electrical and Electronic Engineers)
  - 802.11b: 11 Mbps peak rates, 2.4 GHz frequency
    - First and most widely used form of Wi-Fi today
  - 802.11a: 54 Mbps, 5 GHz frequency
  - 802.11g: 54 Mbps, 2.4 GHz frequency
- These technologies operate in **unlicensed** spectrum

Source: Wi-Fi Alliance, http://www.wifialliance.com

Global Shipments: Mobile Phones vs. PCs

(Millions)

Legend: ■ Mobile Phones   ■ Total PCs*   ■ Mobile PCs (laptops)

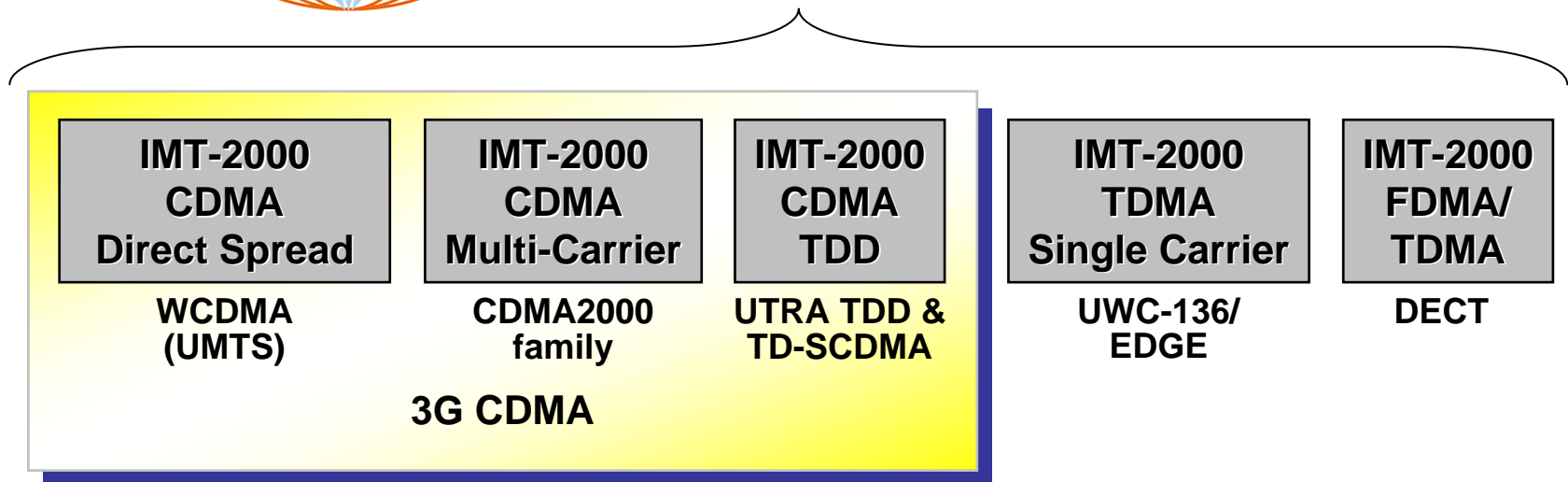* Total PCs include desktop and laptop models

Source: EMC, June 2004, iSuppli Dec, 2003 & Gartner June 2004

What is 3G?

The ITU formed the IMT-2000 program to coordinate development of standards to deliver 3G

IMT-2000 Terrestrial Radio Interfaces

IMT-2000 CDMA Direct Spread	IMT-2000 CDMA Multi-Carrier	IMT-2000 CDMA TDD	IMT-2000 TDMA Single Carrier	IMT-2000 FDMA/ TDMA
WCDMA (UMTS)	CDMA2000 family	UTRA TDD & TD-SCDMA	UWC-136/ EDGE	DECT

3G CDMA

Although there are five terrestrial standards, most of the attention and energy in the industry has been toward the CDMA standards

3G CDMA Evolution – Today and Tomorrow

3G CDMA

Designed for In-Band Migration

1.25 MHz Optimized for Data	**CDMA2000 1xEV-DO**	**Enhanced EV-DO**
	IS-856 Revision 0	**Revision A**

Dedicated for packet data
2.4 Mbps peak rates (fwd link)
1x reverse link rates

DO Gold Multicast, QoS, IMM, video telephony

3.1 Mbps fwd link
1.8 Mbps reverse link

Additional voice capacity doubling – Terminal antenna diversity

1.25 MHz Voice & Data	**CDMA2000 1X**		**1xEV-DV**	
	IS-2000 Release 0	**Revision A**	**Rev. C**	**Rev. D**

Double voice capacity
153.6 kbps packet data

307 kbps packet data
Simultaneous voice and data

3.1 Mbps fwd link
1.8 Mbps reverse link

3.1 Mbps fwd link
1x reverse link rates

Designed for New Spectrum

5 MHz Voice & Data	**WCDMA (UMTS)**		**HSDPA**
	3GPP Release 99	**Rel. 4**	**Rel. 5**

64/384 kbps circuit switched / packet data
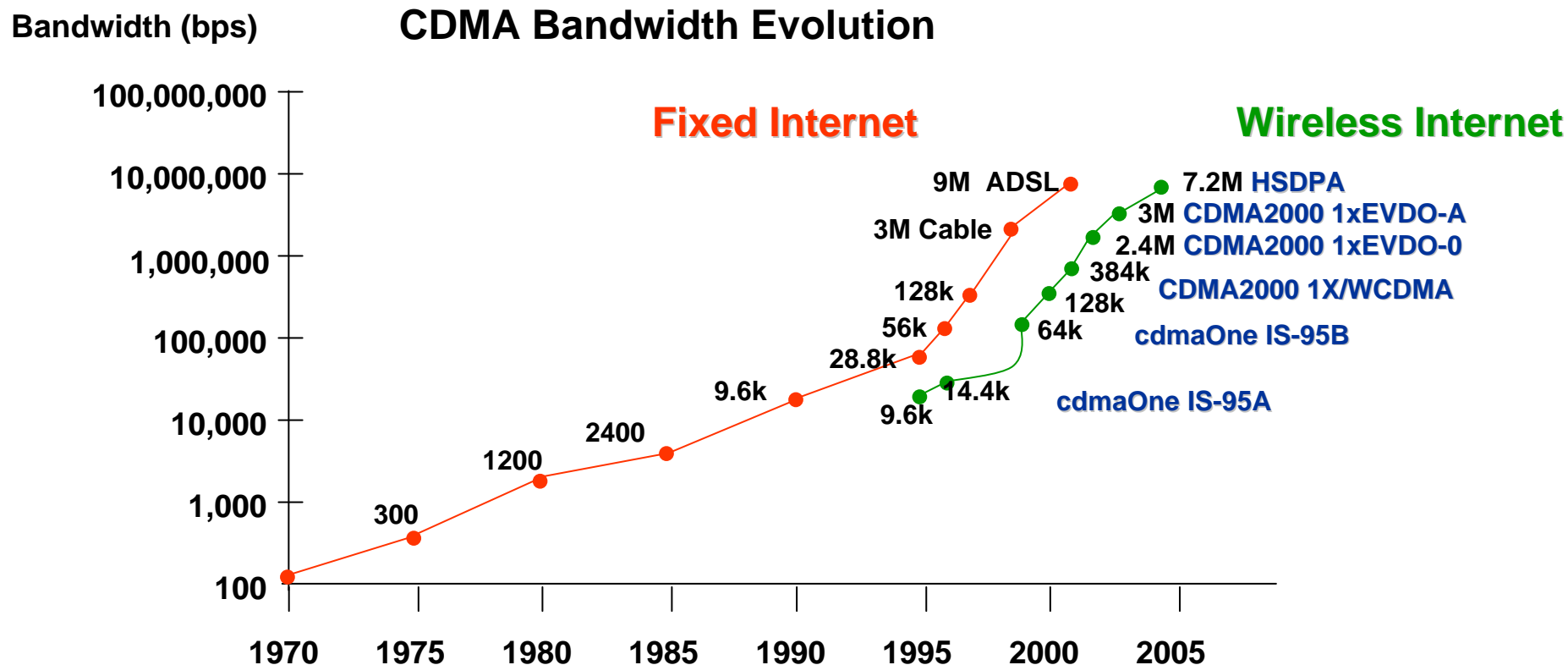Soft handoff

1.8 to 14.4 Mbps fwd link

These enhancements do not require standards modification

2001   2002   2003   2004   2005   2006

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Evolution of Wireless Internet

CDMA Bandwidth Evolution

Bandwidth (bps)

Fixed Internet — **Wireless Internet**

- 100,000,000
- 10,000,000 — 9M ADSL — 7.2M **HSDPA**
- 3M **CDMA2000 1xEVDO-A**
- 3M Cable — 2.4M **CDMA2000 1xEVDO-0**
- 1,000,000 — 384k **CDMA2000 1X/WCDMA**
- 128k — 128k
- 56k — 64k **cdmaOne IS-95B**
- 100,000 — 28.8k
- 14.4k **cdmaOne IS-95A**
- 9.6k — 9.6k
- 10,000 — 2400
- 1200
- 1,000 — 300
- 100

Years: 1970 1975 1980 1985 1990 1995 2000 2005

Mobile Phone vs. PC: Yesterday and Today

Intel Pentium-based desktop computer

- Date: 1996
- Processor: Pentium I
- Speed: 75 MHz
- RAM/Flash: 8 MB
- Drive/Storage: 1 GB
- Price: $1,499 w/o monitor

Mid-line Pentium Notebook

- Date: 2004
- Processor: Pentium 4
- Speed: 2.8 GHz
- RAM/Flash: 512 MB
- Drive/Storage: 60 GB
- Weight: 3,490 grams
- Price: $1399

Qualcomm 80186-based QCP-800 phone

- Date: 1996
- Processor: MSM 2.0
- Speed: 9.8 MHz
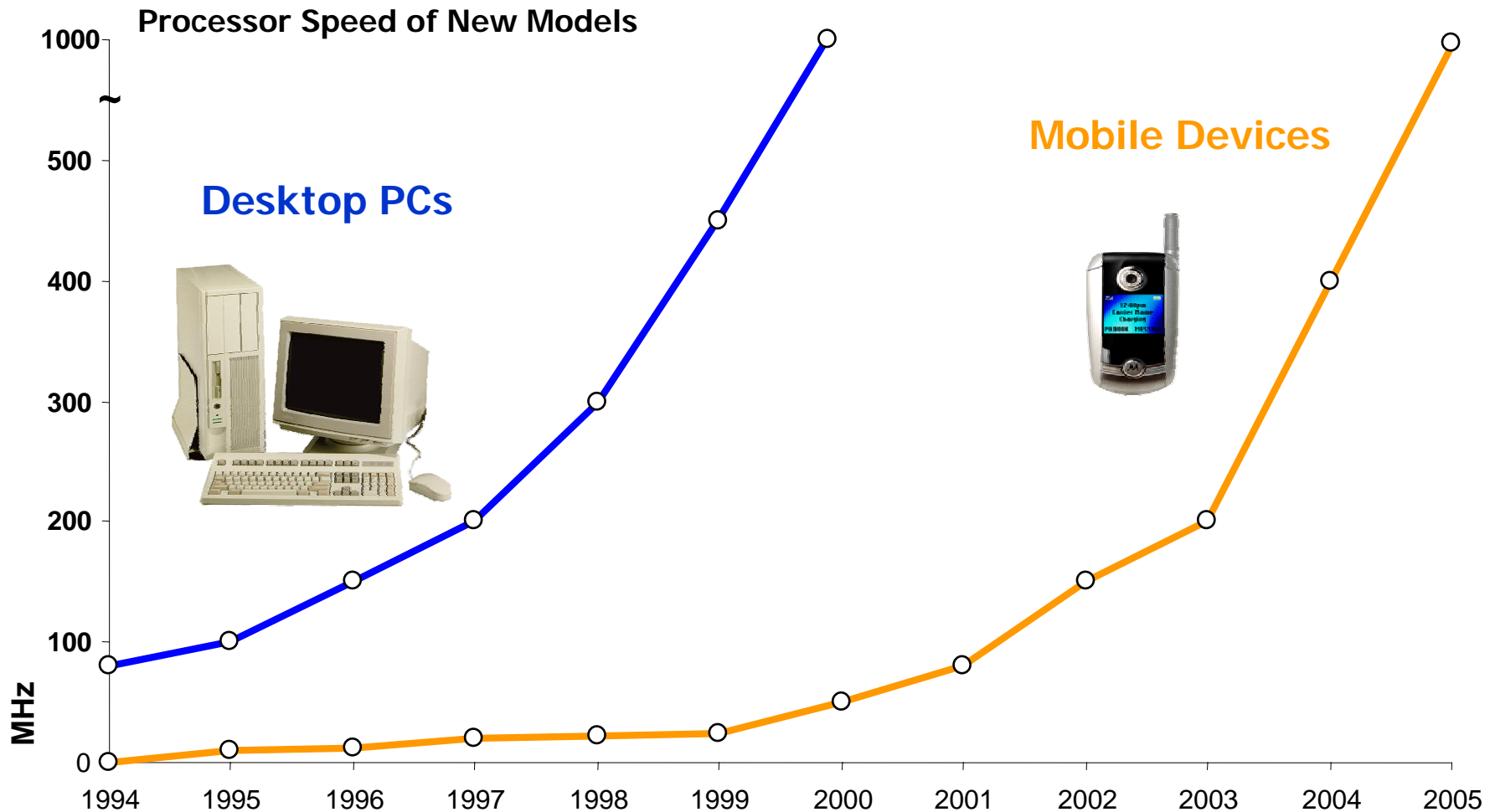- RAM/Flash: 0.5 MB
- Drive/Storage: None
- Price: $500

Samsung ARM7-based SPH-V4200

- Date: 2004
- Processor: MSM5500
- Speed: 40-100 MHz
- RAM/Flash: 76 MB
- Drive/Storage: Up to 512 MB ext storage
  Weight: 90 grams
- Price: $500
- More Features: QVGA, 260K color LCD
  1.3 M pixel camera
  GPS applications
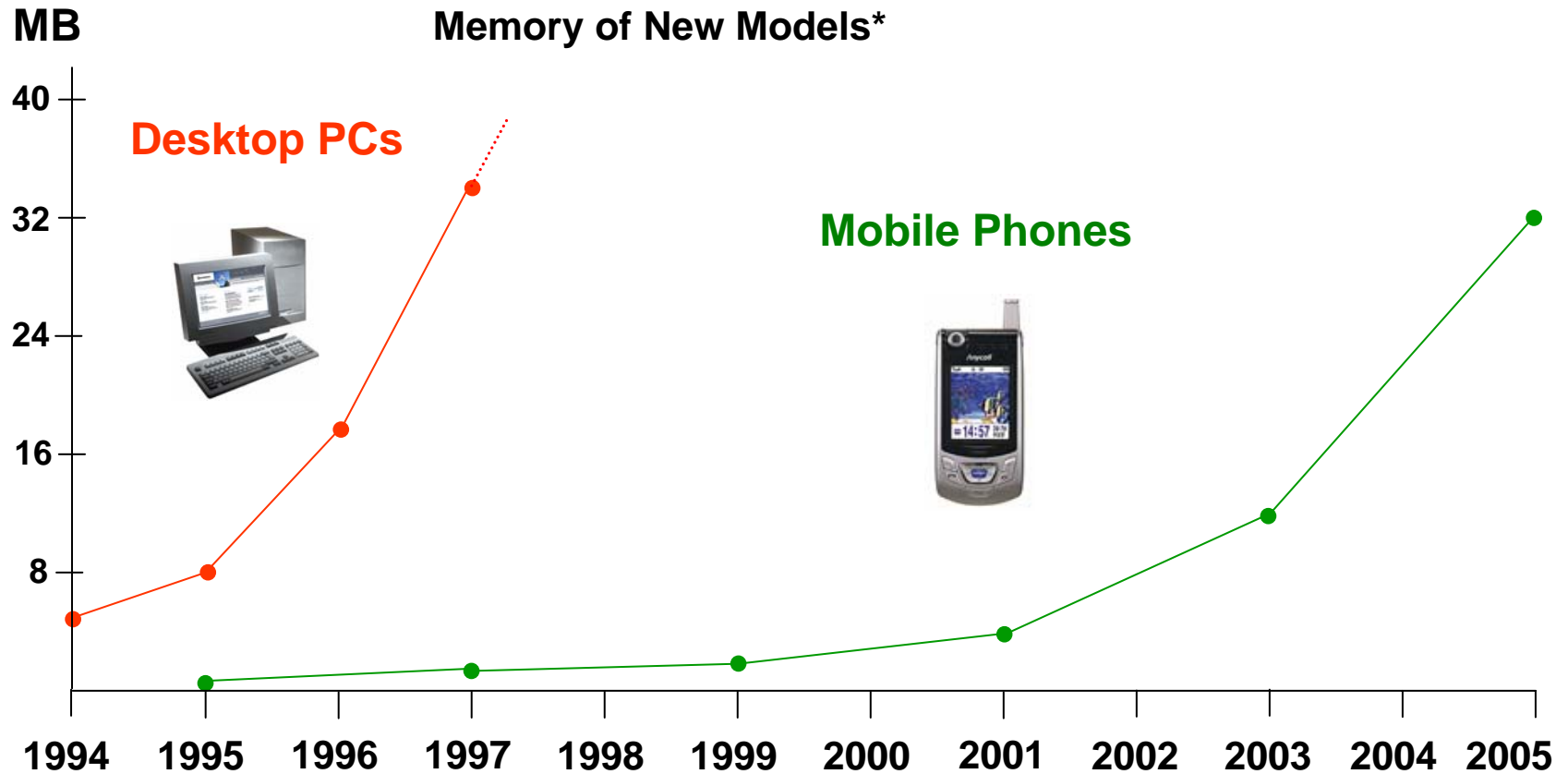 Polyphonic ringers
  Streaming Videos, Music
  BREW

Increasing Mobile Phone Processor Power:
Compares to PCs of the 90's

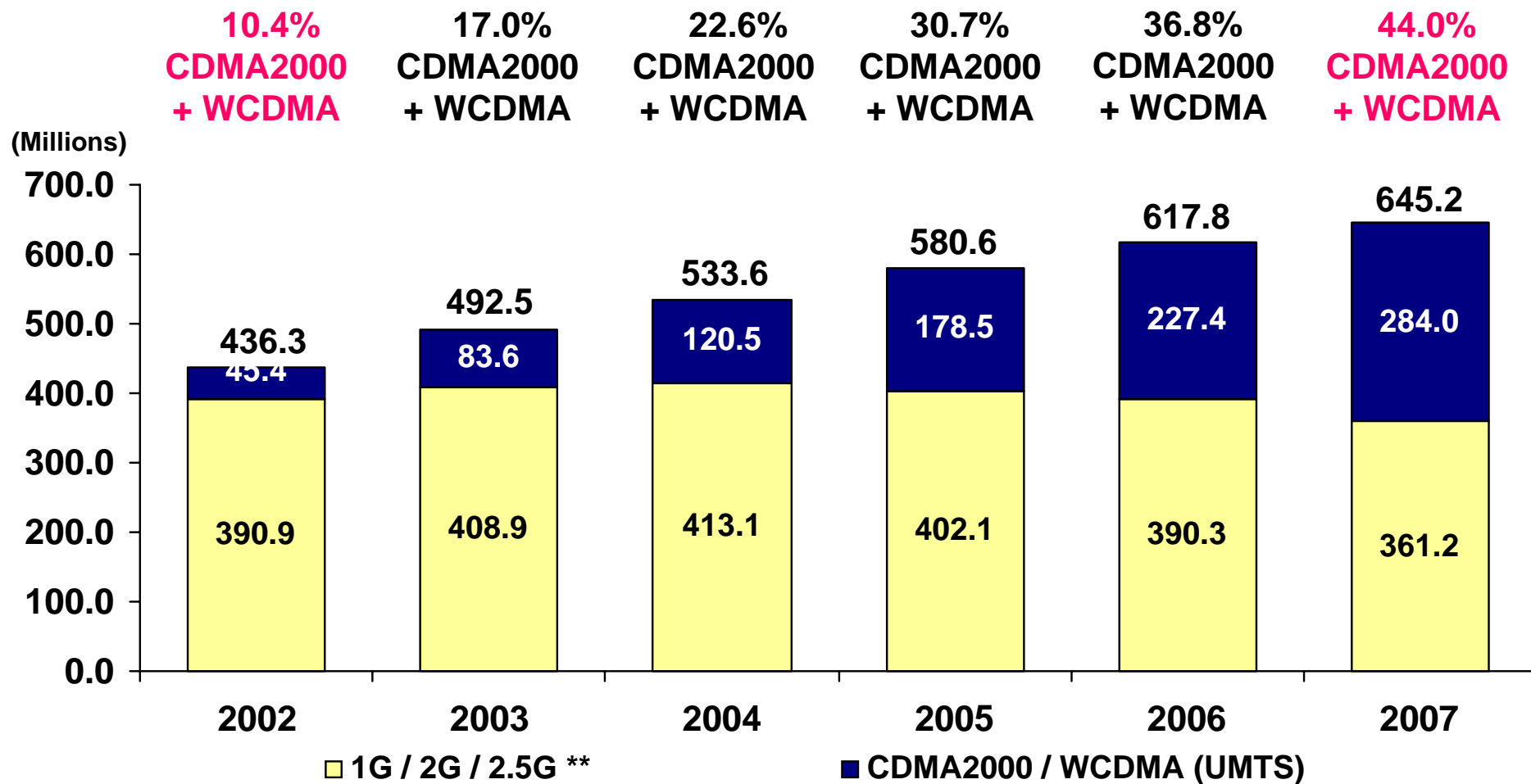**Processor Speed of New Models**

Desktop PCs

Mobile Devices

MHz axis values: 1000, 500, 400, 300, 200, 100, 0

Year axis: 1994, 1995, 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005

Source: Gartner Dataquest, November 2003, QUALCOMM

Mobile Phone Memory Today Compares to Desktop PCs of the 1990's

MB   **Memory of New Models***

Desktop PCs

Mobile Phones

Source: Gartner Dataquest, November 2003

Wireless Handset Sales Growth

	10.4% CDMA2000 + WCDMA	17.0% CDMA2000 + WCDMA	22.6% CDMA2000 + WCDMA	30.7% CDMA2000 + WCDMA	36.8% CDMA2000 + WCDMA	44.0% CDMA2000 + WCDMA
Total	436.3	492.5	533.6	580.6	617.8	645.2
CDMA2000 / WCDMA (UMTS)	45.4	83.6	120.5	178.5	227.4	284.0
1G / 2G / 2.5G **	390.9	408.9	413.1	402.1	390.3	361.2
Year	2002	2003	2004	2005	2006	2007

(Millions)

☐ 1G / 2G / 2.5G **   ■ CDMA2000 / WCDMA (UMTS)

** Includes Analog, cdmaOne, GSM/GPRS/EDGE, TDMA, iDEN and PDC

Source: IDC, The Shosteck Group and The Yankee Group (2004)

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3G CDMA Cards Available Around the World

KDDI DO Card

KDDI Kyocera W01K

Verizon Sierra Wireless PC5220

WCDMA

Vodafone Mobile Connect 3G/GPRS datacard

SK Telecom GTRAN Surfer 6000

MSM Roadmap

Platform	CDMA2000	CDMA2000 + GSM-GPRS					WCDMA (UMTS)	
	1X	1X	1xEV-DO (Rev. 0)	1xEV-DV (Rev. D)	1xEV-DO (Rev.A)	+ UMTS/ HSDPA	GSM/GPRS	EDGE/HSDPA
CONVERGENCE PLATFORM — Dual CPU, Single Chip					7500 1Q '05	7600 2006		7200 4Q '05
ENHANCED PLATFORM — Enhanced Multimedia & Graphics	6150 2Q '04		6550 2Q '04	6700 4Q '04	6800 1Q '05			6280 2H '05 / 6275 4Q '04
MULTIMEDIA PLATFORM — Multimedia & 2D/3D Graphics	6100 3Q '02	6300 3Q '02	6500 2Q '03				6225 MID '04 / 6250 2Q '03	
VALUE PLATFORM — Integrated gpsOne, Voice & Data, Voice	6050 1Q '02 / 6025 3Q '03 / 6000 1Q '02						6200 2Q '02	

MULTIMODE | All GSM/GPRS Capable

QCT Product Platforms

| SAMPLING	PLATFORMS	COMMON CORE FEATURES
'05 -'06	convergence Platform QUALCOMM	• Dual CPU • 6.0 megapixel digital camera • 30 fps digital video record & playback • 4M triangles/sec. 3D graphics acceleration • High-fidelity digital stereo audio record/playback
'04 -'05	enhanced Platform QUALCOMM	• QVGA • Multimedia, data-centric • Integrated Launchpad features: QCamera, CMX, Qtv, gpsOne
'03 -'04	multimedia Platform QUALCOMM	• QCIF • Multimedia • Integrated Launchpad features: Qcamera, CMX, Qtv, gpsOne
'02 -'03	value Platform QUALCOMM	• Sub-QCIF • Voice-centric • Limited Launchpad support

120+ Designs

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CDMA2000 1xEV-DO: Affordable Wireless High Speed Data

2.4 Mbps Peak Rate, Lowest Cost per Mbyte

QUALCOMM

San Diego, CA
USA
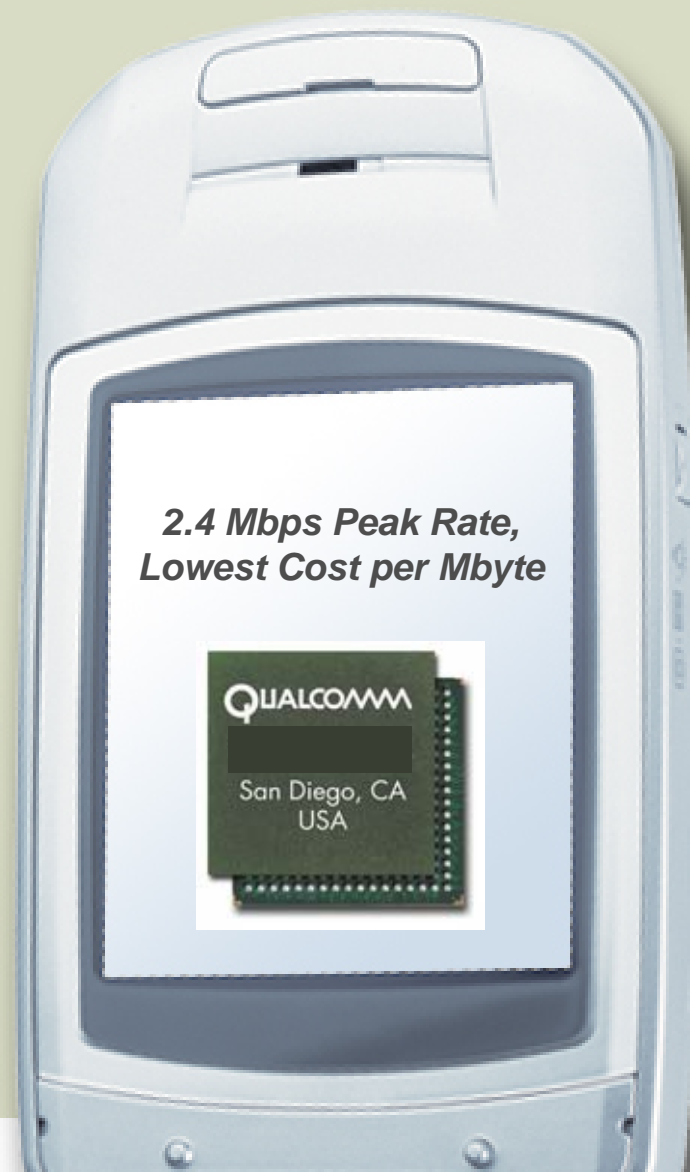
What is CDMA2000 1xEV-DO

- **1xEV-DO – EVolution, Data Optimized**
  - Full name is CDMA2000 1xEV-DO - part of the 3G CDMA family
- **Delivers data at rates up to 2.4 Mbps today**
  - Average data rates in the hundreds of kbps
  - Typically 300 kbps – 600 kbps
- **Fixed, portable or fully mobile use**
  - "Always-on" experience
- **Cost-effective for operators, requires little spectrum**

- **1xEV-DO is a 3G data evolution for CDMA operators**
- **Data and voice handoffs with CDMA**
- **Devices are backward/forward compatible**
- **Incremental upgrade over current CDMA2000 1X network**
- **1xEV-DO works seamlessly with existing, IP-based network infrastructure**

- **1xEV-DO Rev A: Standards based upgrade with higher data rates**
  - 3.1 Mbps on the forward link and 1.8 Mbps on the reverse link

CDMA2000 1xEV-DO

~7 Million Subscribers and Growing

Coming Soon

(Telecsa Ecuador)

	Qualcomm
EV-DO Rel 0	**5500** San Diego, CA USA
EV-DO Rel 0, GSM/GPRS	**6500** San Diego, CA USA
EV-DO Rel 0, GSM/GPRS	**6550** San Diego, CA USA
EV-DO Rel 0, EV-DV, GSM/GPRS	**6700** San Diego, CA USA
EV-DO Rev A, GSM/GPRS	**6800** San Diego, CA USA
EV-DO Rev A, GSM/GPRS	**7500** San Diego, CA USA
EV-DO Rev A, GSM/GPRS, WCDMA	**7600** San Diego, CA USA

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Verizon Wireless Going Nationwide With Flat-Rate EV-DO

- **CDMA2000 1XEV-DO deployment to go beyond the current two markets -- San Diego and Washington, D.C.**

- **Offered at $79.99 flat rate, all-u-can eat pricing, 1xEV-DO offers speeds of 300 to 500 kilobits per second, or about 10 times the average dial-up connection speed...**

- **30% of POPs covered by 2004**
  - **Nationwide by 2005**

- **Verizon says it will spend $1 billion over the next two years to launch the EV-DO network... the company's nationwide deployment will be marketed to both consumers and enterprises...**

BROADBAND ACCESS COVERAGE AREA

Washington DC Area

San Diego Area

Source: Verizon Wireless, January 2004

Laptops & Wireless Integration

Wireless LAN

- In 2002, <20% of all laptops shipped had an integrated WLAN solution

- By 2006, approximately 95% of all laptops shipped will have WLAN integrated

Source: IDC, July 2003

Wireless WAN

- Products such as the Panasonic Toughbook are currently available with an integrated WWAN solution (enterprise focus)

- Within the next 2 years computer manufacturers will offer mass-market laptops with an integrated WWAN solution

  - QUALCOMM is actively working with laptop manufacturers, carriers and regulators to help bring these products to market

  - PCMCIA WWAN data cards are currently available for consumer/enterprise use

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Over 60 1xEV-DO Devices…*commercially introduced*

$600+ range:

Samsung MITS M400
207 grams

$501 - $600:

Samsung SCH-V420
90 grams

Sierra Wireless PC5220
50 grams

Kyocera W01K
55 grams

GTRAN DotSurfer 6000
35 grams

$401 - $500:

Samsung SPH-E1700
115 grams

Samsung SCH-E170
110 grams

Samsung SCH-V410/SPH-V4300
108 grams

Samsung SCH-E300
90 grams

Samsung SCH-V310
129 grams

Samsung SCH-V350
95 grams

SK Teletech IM-6400
104 grams

PC Cards from $150:

GTRAN DotSurfer 6210
35 grams

$301 - $400:

Samsung SCH-E250/SPH-E2500
90 grams

Samsung SPH-E2000
97 grams

Samsung SPH-V3000
128 grams

Samsung SCH-V300
110 grams

Samsung SCH-E370
105 grams

Samsung SCH-E140
91 grams

Motorola MS-150
82 grams

LG LG-KV1300/LG-SV130
110 grams

SK Teletech IM-6500
100 grams

SK Teletech IM-6100
101 grams

$201 - $300:

KTF E2500
79 grams

Samsung SCH-E110
95 grams

Samsung SCH-E160
96 grams

Samsung SCH-E130
85 grams

Samsung SCH-E120
81 grams

Samsung SCH-E135
74 grams

Samsung SCH-E150
113 grams

Samsung SPH-E1000
91 grams

Samsung SCH-E100
89 grams

LG LG-KH5000
110 grams

LG LG-KV1100 (CYON)
90 grams

$101 - $200:

Motorola V740 (Appeal TT800)
80 grams

SK Teletech IM-6200
80 grams

Hitachi W11H
125 grams *

Kyocera W11K
128 grams *

Hyundai PG-S1200, K1200, L1200 (Curitel)
92 grams

KTF E2000
79 grams

Hyundai PS-E100 (Curitel)
91 grams

SK Teletech IM-5300
95 grams

Motorola MS-100
80 grams

LG LG-SV110 (CYON)
90 grams

Source: Retail pricing from South Korea, except when marked (*) which denotes Japanese retail price; PC cards from Korea, Japan, and the United States

Over <u>60</u> 3G CDMA2000 1xEV-DO Handsets Available Today

South Korea Handset Market: New Models

KTFT KTF-E2000 (MMS)
- Network: EV-DO
- Screen Type: 65K LCD
- Sound: 40 poly
- Camera: 110K pixels

Samsung SPH-V3000 (Video-On-Demand)
- Network: EV-DO
- Screen Type: 262K LCD
- Sound: 40 poly
- Camera: 110K pixels

Pantech & Curitel PG-1200 (64 Polyphonic)
- Network: 1X
- Screen Type: 65K LCD
- Camera: 330K pixels
- Add'l Features: GPS, 3D Sound, Dual Speaker

LG KV-1300 (Camcorder)
- Network: EV-DO
- Screen Type: 260K LCD
- Sound: 40 poly
- Add'l Features: 1 hour recording time, 64 MB Flash memory

Samsung SCH-V330 (Video Mail)
- Network: EV-DO
- Screen Type: 262K LCD
- Sound: 40 poly
- Camera: 300K (CMOS)
- Add'l Features: GPS, Video Mail

Samsung SCH-V310 (Video Telephony)
- Network: EV-DO
- Screen Type: 262K LCD
- Sound: 40 poly
- Camera: 110K pixels
- Add'l Features: GPS

Samsung MITs-M400 (EV-DO PDA)
- Screen Type: 650K LCD
- Camera: 300K pixels
- Add'l Features: Internal TV tuner; Pocket PC 2002 Phone Edition

CDMA2000 1xEV-DO Device Trends

Retail prices have dropped 60% in 2 years: from $700 in January '02 to less than $200 in January '04
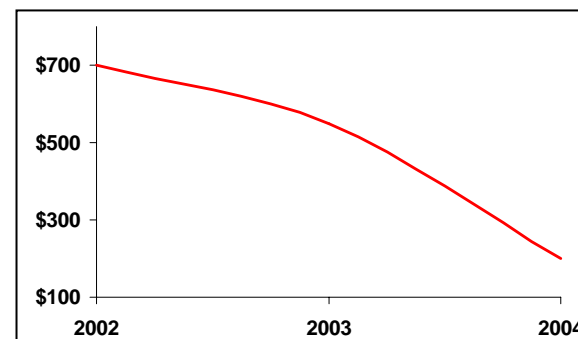
- **100 grams or less a standard**
- **Higher-resolution LCD's with tens or hundreds of thousands of colors, new phones incorporate QVGA screens**
- **Majority of the devices have cameras, mostly video and new phones have more than a megapixel resolution**
- **Audio and video players for MPEG4, MP3, AAC downloads, many have streaming capability for real-time content delivery**

What's Next for CDMA2000 1xEV-DO?

Quality of Service (QOS)
Selectable levels of
priority, latency

VoIP

**Instant Messaging
Instant Multi-media**
Audio and video

PERSONAL
BROADBAND

Rev A – Higher Data Rates
3.1 Mbps - forward link
1.8 Mbps on reverse link
(Same as 1X Rev D)

Next Level
Enhancements

Receive Diversity
Increased capacity in
1.25 MHz

Multi-cast
Higher efficiency
Multiple channels

Equalizer
Increase sector
capacity 20-60%

CDMA2000 1xEV-DO Rev A and OFDMA

- **OFDMA data rates similar to 1xEV-DO Rev A**

- **1xEV-DO is commercial today, many devices, many manufacturers, 1X coverage**

- **1xEV-DO uses standard Internet interconnects**

	Peak Rates	Uplink Average Throughput
1xEV-DO Rel 0 Dual Receive Rx	Uplink: 153 kbps Downlink: 2.4 Mbps	~ 300 kbps
1xEV-DO Rev A Dual Receive Rx	Uplink: 1.8 Mbps Downlink: 3.1Mbps	~ 600 kbps
1xEV-DO Rev A Quad Receive Rx	Uplink: 1.8 Downlink: 3.1Mbps	~ 900 kbps

- **6800 Series Improved Downlink**
  - **Dual Receive Diversity**
  - **Equalizers**
  - **Hybrid Free Operation**

- **Advantages of EV-DO Family**
  - **Time To Market**
  - **Backward Compatible**
  - **Pin-Compatible Chip Solutions**
  - **Standardized in ITU**
  - **Standardized in 3GPP2**
  - **Over 60 handset models available today**

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User Based Quality of Service (QoS) Classifies User

- **Users have different levels of priority based on their subscription (Executive, Premium, Standard)**

- **Implemented in CDMA2000 1xEV-DO Rel.0 with software upgrade to BTS**

High Priority Packets — GOLD USER CLASS

Medium Priority Packets — SILVER USER CLASS

Low Priority Packets — BRONZE USER CLASS

Application Based Quality of Service (QoS) Classifies Applications

- **Different priority based on delay tolerance**
- **Delay sensitive applications can have higher priority**
- **Applicable to one user's traffic as well as across all users**

Highest Priority Applications — 01001110101011010101010010110101001010 — **VoIP, Low Latency Games, Video Conferencing**

Some Delay Tolerance due to Buffering — **Streaming Video and Audio**

More Delay Tolerance — 010101001011 — **Web Browsing, E-mail**
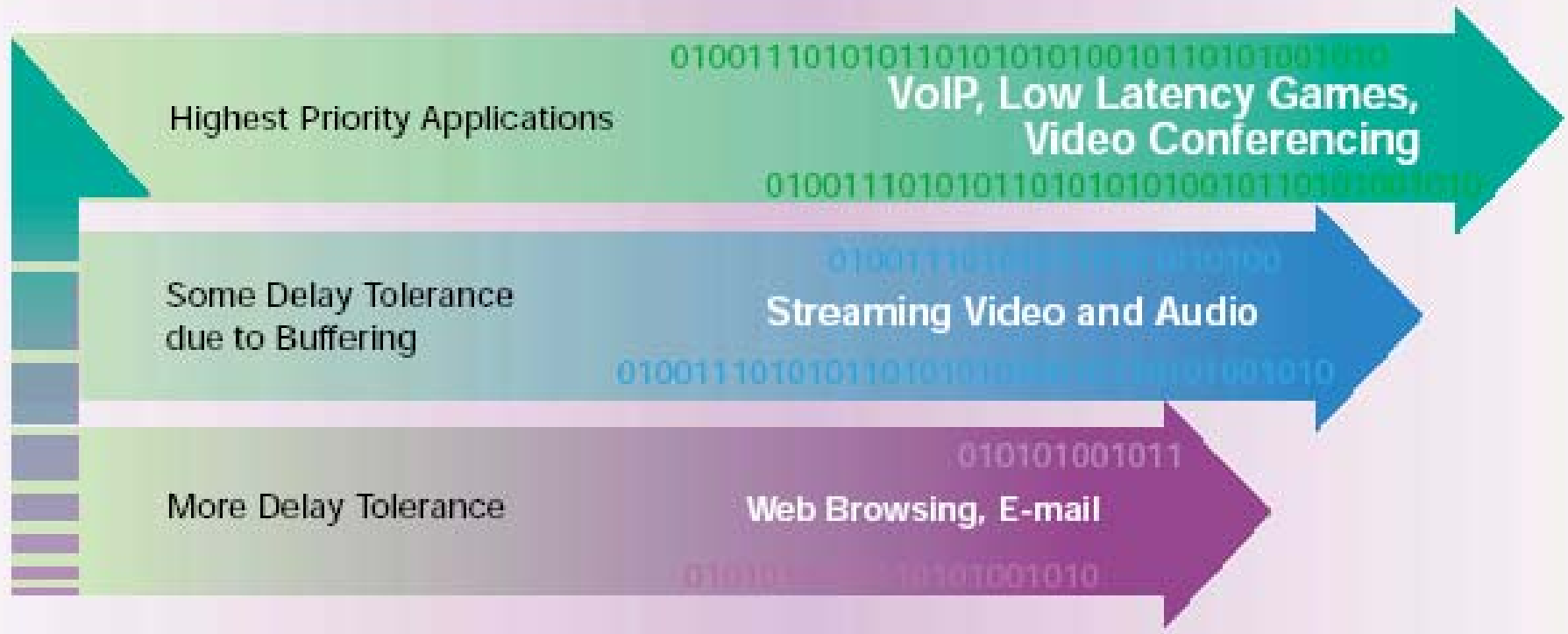
EV-DO Gold Multicast

- Each channel may be transmitted at different rates and different BTS' may transmit multiple channels

- No physical layer changes to EV-DO Rev 0

- Software upgrade only, channel cards not affected

- Flexibility in allocating portions of the forward link to EV-DO unicast services vs. Multicast

- Information delivered encrypted over the air

- Standard mechanism leveraged for the device to request specific services and be authenticated

Improve Efficiency with Multicasting
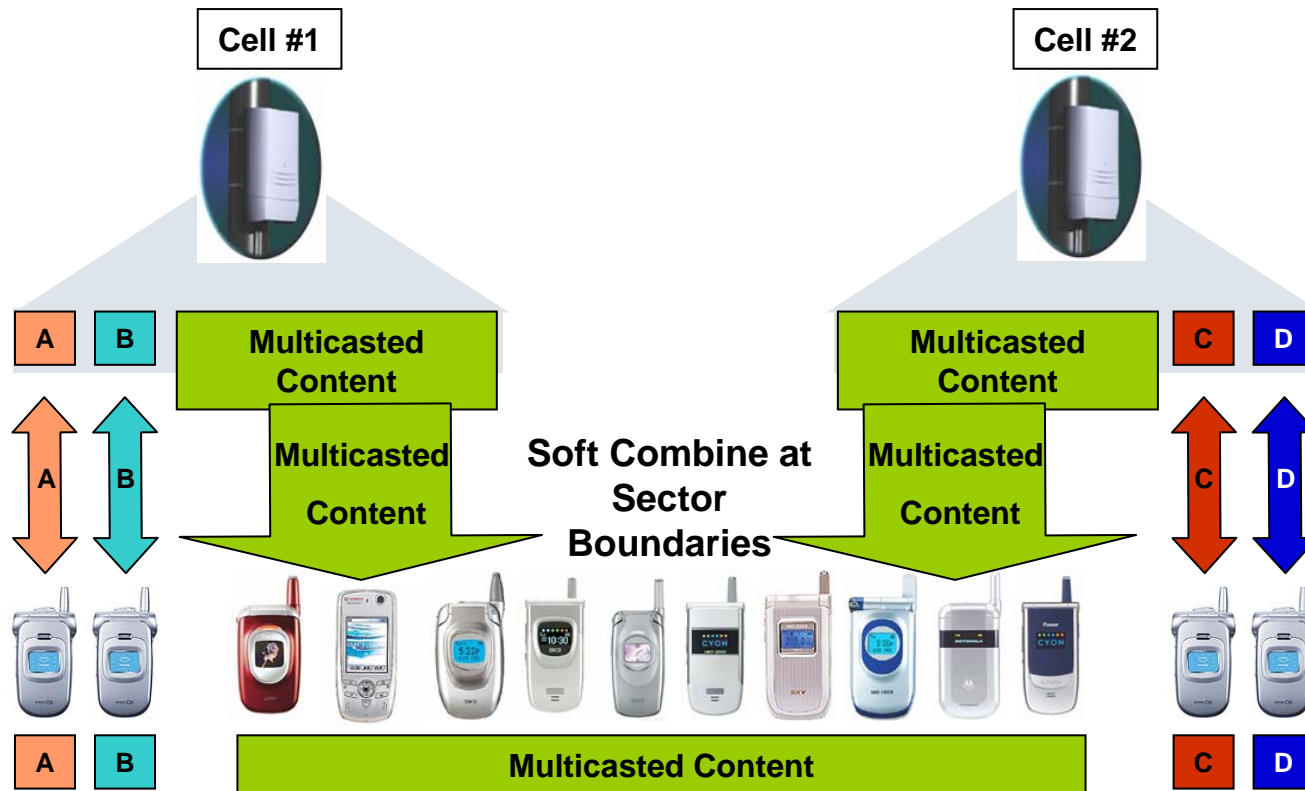
1xEV-DO Going Forward: Instant Multi-Media (IMM)

- Combines the best of video conferencing and group services
- Everyone in the group receives audio and video from the originator
- Both audio and video can come from one user or two different users (separate audio and video floors)

Audio and Video from Same Source
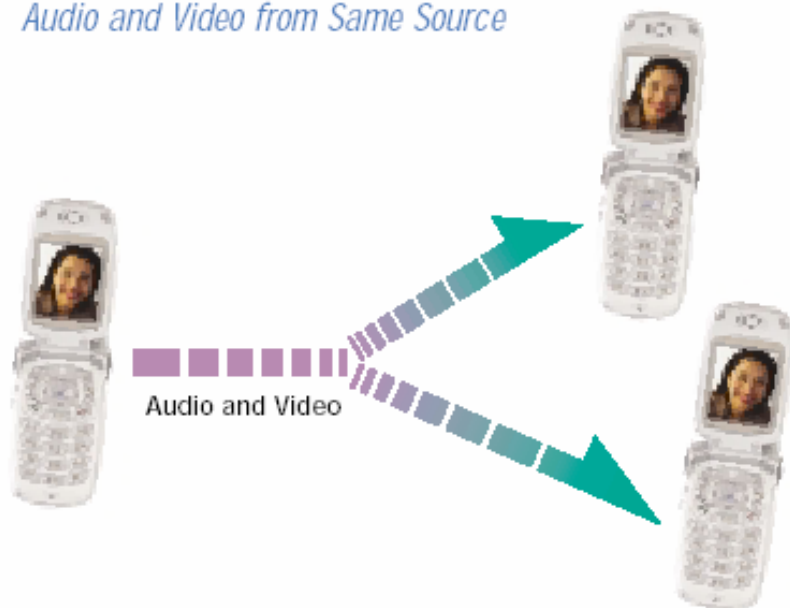
Audio and Video

Audio and Video from Two Different Sources

Audio

Video

1xEV-DO Going Forward: Rich Location Based Services

Location Based Services over CDMA2000 1xEV-DO
- **Rich multimedia content coupled with location based services**
- **CDMA2000 1xEV-DO fast downloads enable location relevant information with an improved user experience**
- **Location information acquired over CDMA2000 1xEV-DO airlink along with the rich content**

Movie Trailer   Video   Pictures

Advertisement   High Res. Images   Maps

HIGH SPEED Downloads based on Location Information
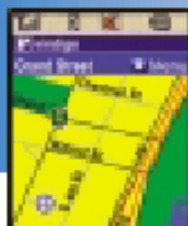
CDMA2000 1xEV-DO Video Telephony (VT)
Simultaneous Voice and Video – High Quality and Efficiency

- **SKT launched July 2003, KTF announced plans to launch 2004**

- **Packet (CDMA2000 1xEV-DO) based VT more efficient and flexible**
  - **Voice and video inherently variable rate**
  - **High throughput for medium QoS Video**

- **CDMA2000 1xEV-DO QoS solution: "Rev0+QoS"**
  - **3GPP2 published in April 2004**

- **Quality & Capacity Improvements with Rel. A**

"Push to See"

Samsung SCH V310

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South Korea CDMA Market
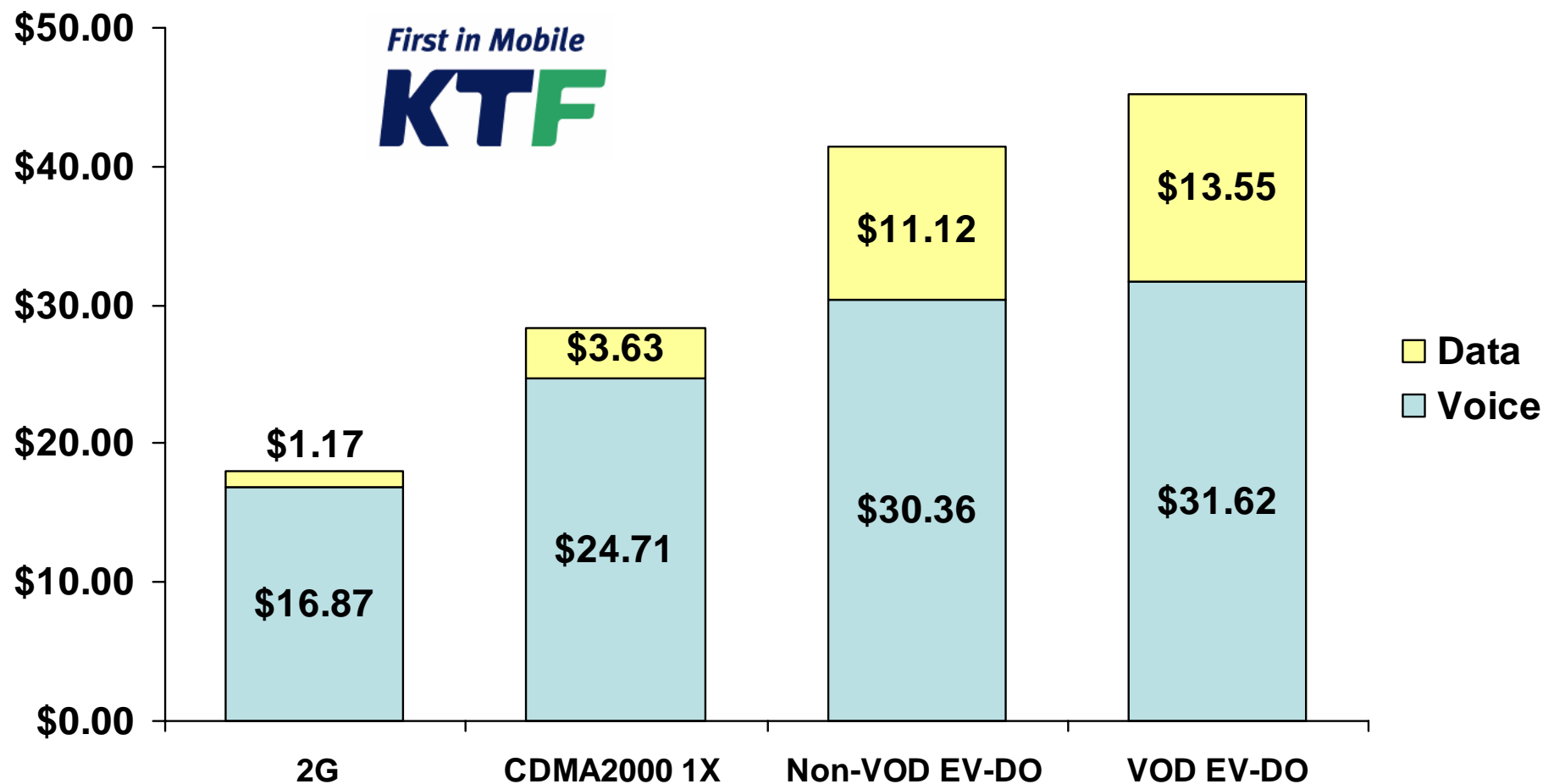## *Population 49M, Wireless Penetration 69%, CDMA Penetration 100%*

- **Number portability**
- **Continued replacement cycle**
- **CDMA2000 1xEV-DO continuing to grow**
- **Limited WCDMA launch, meets MIC licensing terms**

South Korea CDMA2000 1xEV-DO Subscribers (Millions)

SKT expects 8-9 million CDMA2000 1xEV-DO subscribers in 2004

	Dec'02	Mar'03	Jun'03	Sept'03	Dec'03	Jan'04	Mar'04
	173,977	699,673	1,656,406	2,965,556	4,378,621	5,200,000	6,402,000

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Source: Ministry of Information and Communication, Digital Times, U.S. Census Bureau, EMC January 2004
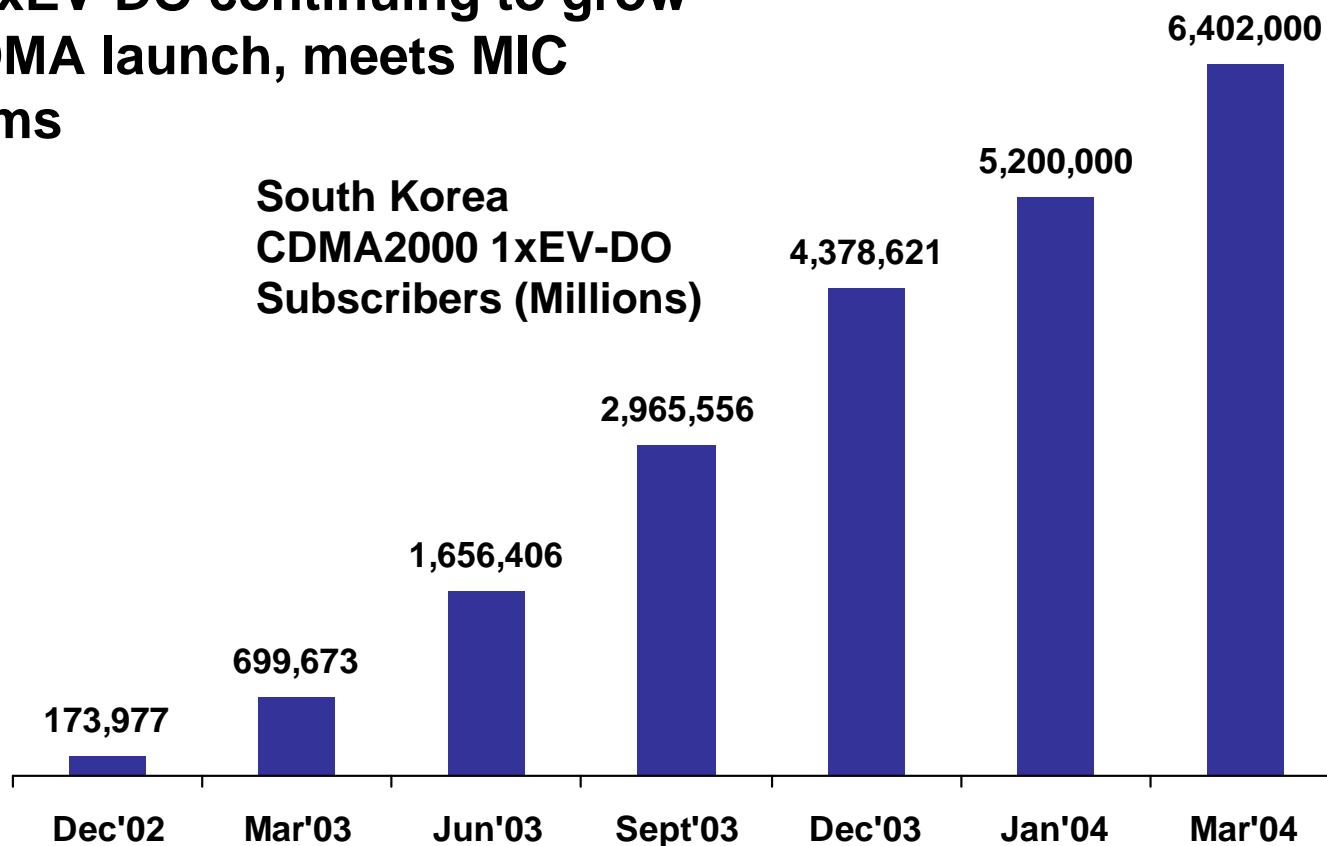
KTF Monthly Voice and Data ARPU by Device Type Q4'03

PDA's – Enabling Mobile Wireless Data

Hitachi SH-G1000

CDMA2000 1X
Commercially Launched – July 2003
Operator(s) - Sprint PCS

SPECIFICATIONS
153 kbps data capable , 238 grams

65K color TFT-LCD, 150 min Talktime
168 hr Standby

Built-in rotating VGA camera
gpsOne enabled
Pocket PC 2002, Phone Edition

SD Card Slot
Voice-activated dialing

Sharp SH2101V
(FOMA)
WCDMA

Samsung MITS
M400

LG Telecom PCD-200

Cellvic mycube
V100

HTC Hutch ICE

PC-EPhone
Cyberbank POZ

Handspring
Treo 600

Audiovox Thera

RIM
BlackBerry 6750

Samsung
SPH-i330/
MITS M330

G.MATE
YOPY YP3500

Motorola
A920

Samsung
NEXiO
S150

Samsung
SPH-i500

Cellvic XG

UCSD CyberShuttle - First Bus to Offer 802.11b With CDMA2000® 1xEV-DO Internet Connection

- **Riders with a laptop or handheld computer equipped with WLAN connect to access point in the bus, which communicates with the Internet by 3G network**

- **No extra payment required**

- **2.4 Mbps peak, 600–800 KBPS average fully supported bus load of students/faculty**
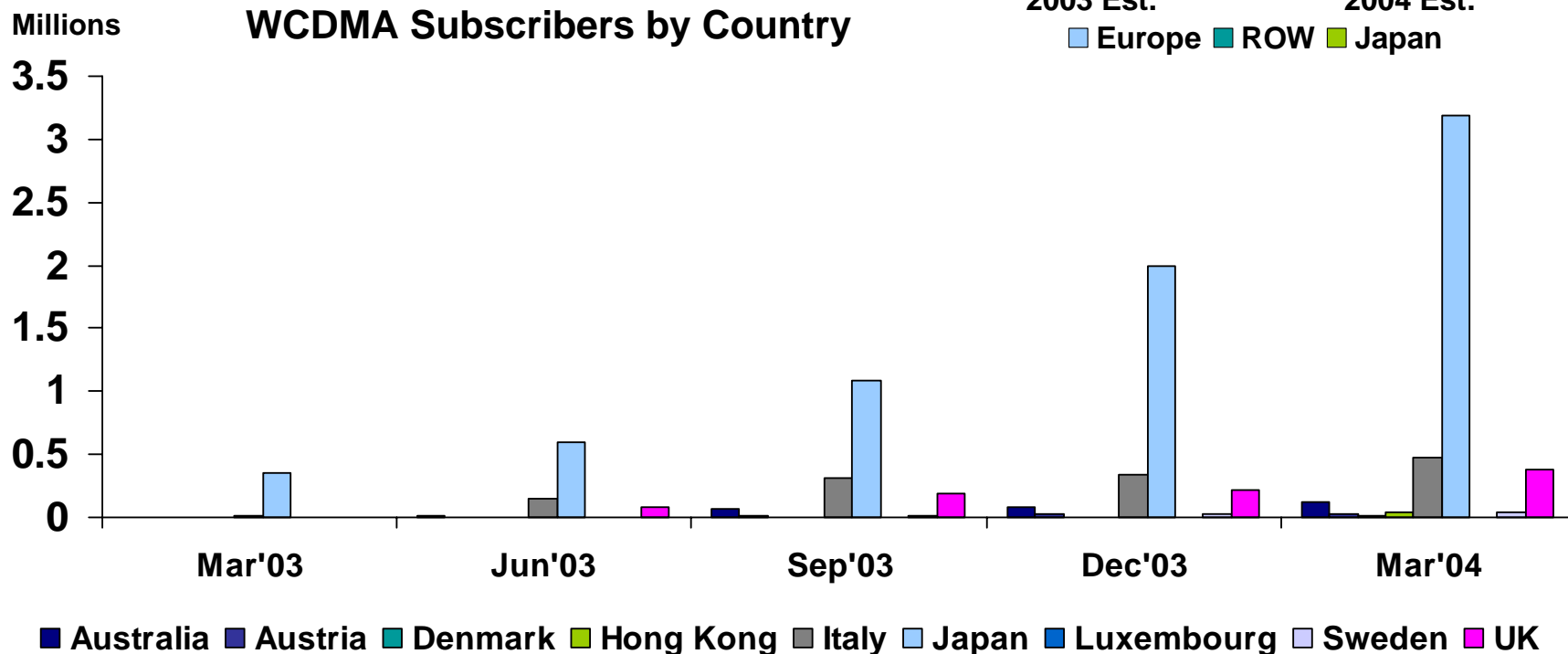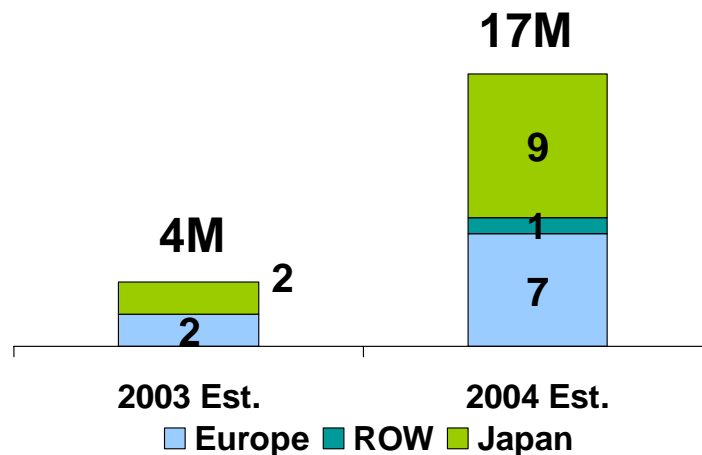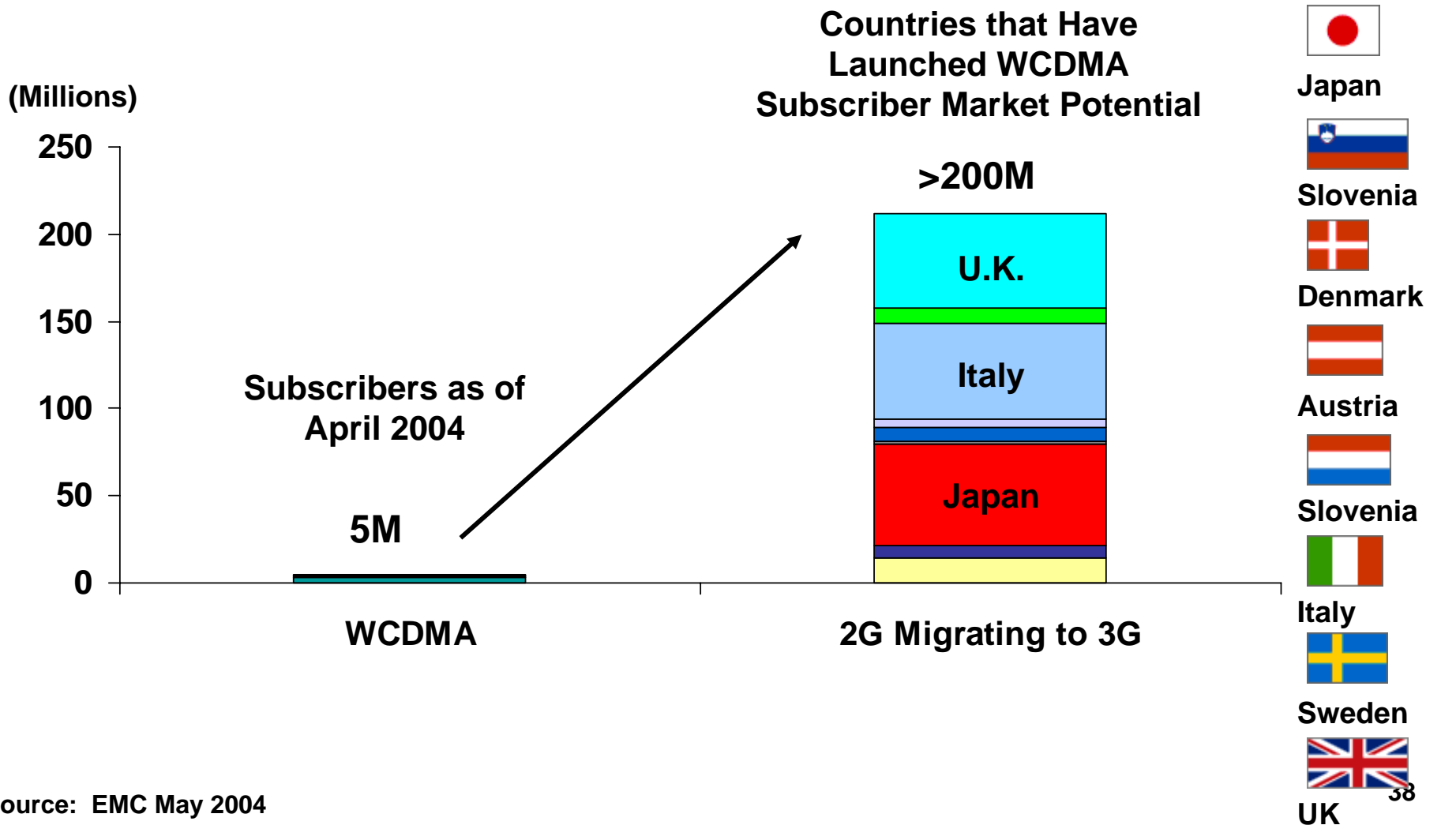
- **Popular service**

WCDMA (UMTS)

2G to 3G Migration Has Begun GSM => WCDMA
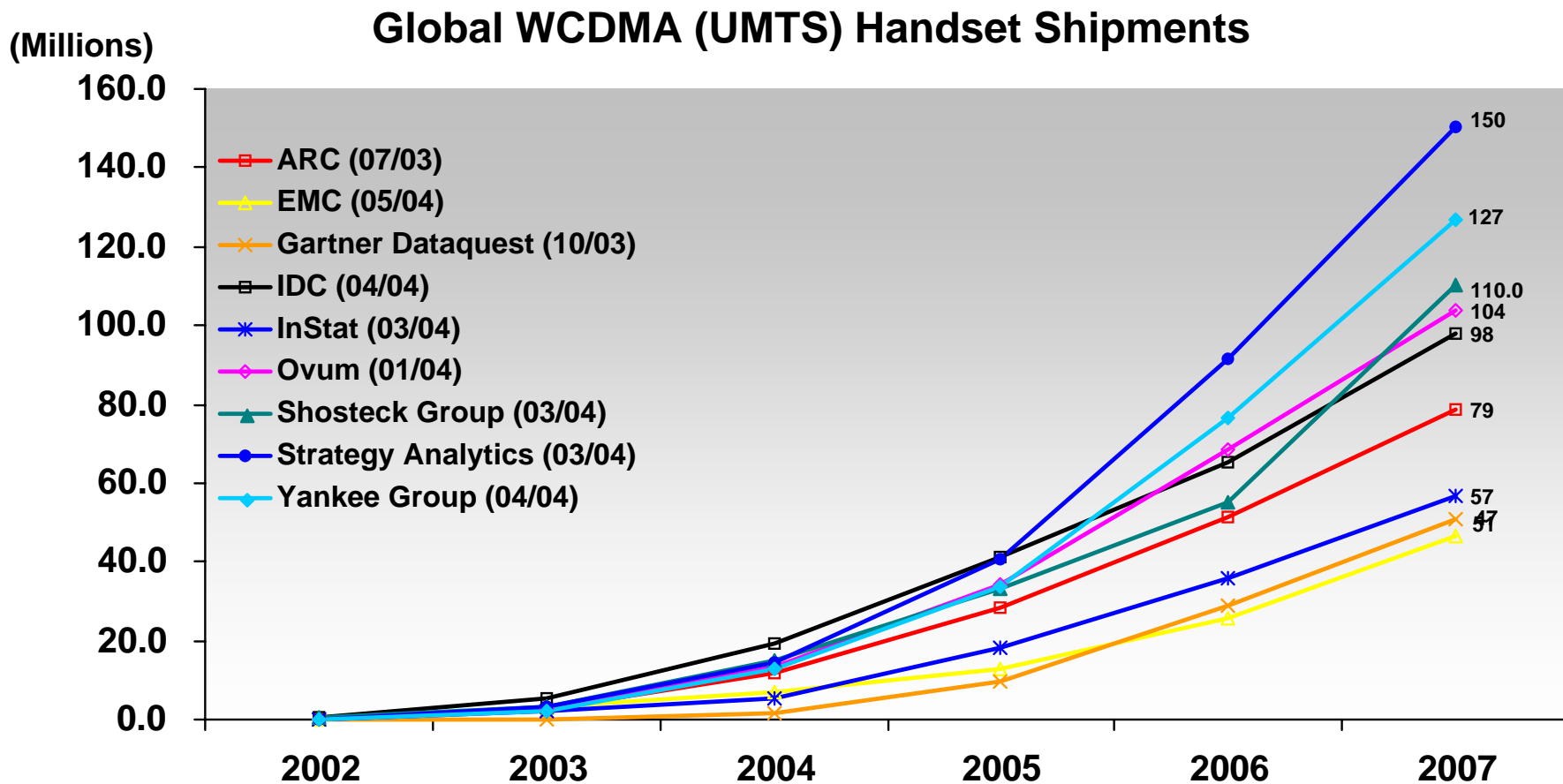
QUALCOMM WCDMA Handset Estimate As of April 21, 2004

17M

9

1

7

4M

2

2

2003 Est.   2004 Est.

■ Europe ■ ROW ■ Japan

WCDMA Subscribers by Country

Millions

3.5
3
2.5
2
1.5
1
0.5
0

Mar'03   Jun'03   Sep'03   Dec'03   Mar'04

■ Australia ■ Austria ■ Denmark ■ Hong Kong ■ Italy ■ Japan ■ Luxembourg ■ Sweden ■ UK

Source: EMC May 2004

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WCDMA Transition Gaining Momentum
Large Potential From Existing 2G PDC and GSM Subscribers

Countries that Have Launched WCDMA Subscriber Market Potential

(Millions)

>200M

Subscribers as of April 2004

5M

U.K.

Italy

Japan

WCDMA

2G Migrating to 3G

Australia

Hong Kong

Japan

Slovenia

Denmark

Austria

Slovenia

Italy

Sweden

UK

Source: EMC May 2004

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WCDMA (UMTS) Growth Opportunity

(Millions)

Global WCDMA (UMTS) Handset Shipments

- ARC (07/03)
- EMC (05/04)
- Gartner Dataquest (10/03)
- IDC (04/04)
- InStat (03/04)
- Ovum (01/04)
- Shosteck Group (03/04)
- Strategy Analytics (03/04)
- Yankee Group (04/04)

150
127
110.0
104
98
79
57
47

Signed Over 55 WCDMA (UMTS) License Agreements

Same Royalty Rate by Manufacturer Regardless of Standard

Licensed manufacturers include:

- **Agilent**
- **Alcatel**
- **DENSO**
- **Ericsson**
- **Fujitsu**
- **Hitachi**
- **Hyundai**
- **Kenwood**

- **Kyocera**
- **LG Electronics**
- **Lucent**
- **Mitsubishi Electric**
- **Motorola**
- **NEC**
- **Nokia**
- **Nortel Networks**

- **Panasonic**
- **Philips**
- **Samsung**
- **Sanyo**
- **Sharp**
- **Siemens**
- **Toshiba**

Hutchison Whampoa Ltd.

NTT DoCoMo

Many Ways QUALCOMM Helps WCDMA Operators

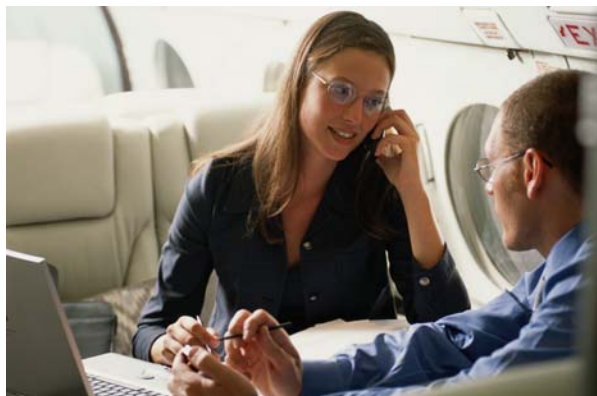**Network testing**

**WCDMA chips & support
21 customers to date**

**Interoperability
testing**

**Interacting with
operators on feature sets**

Sanyo VSA701

QUALCOMM test phone

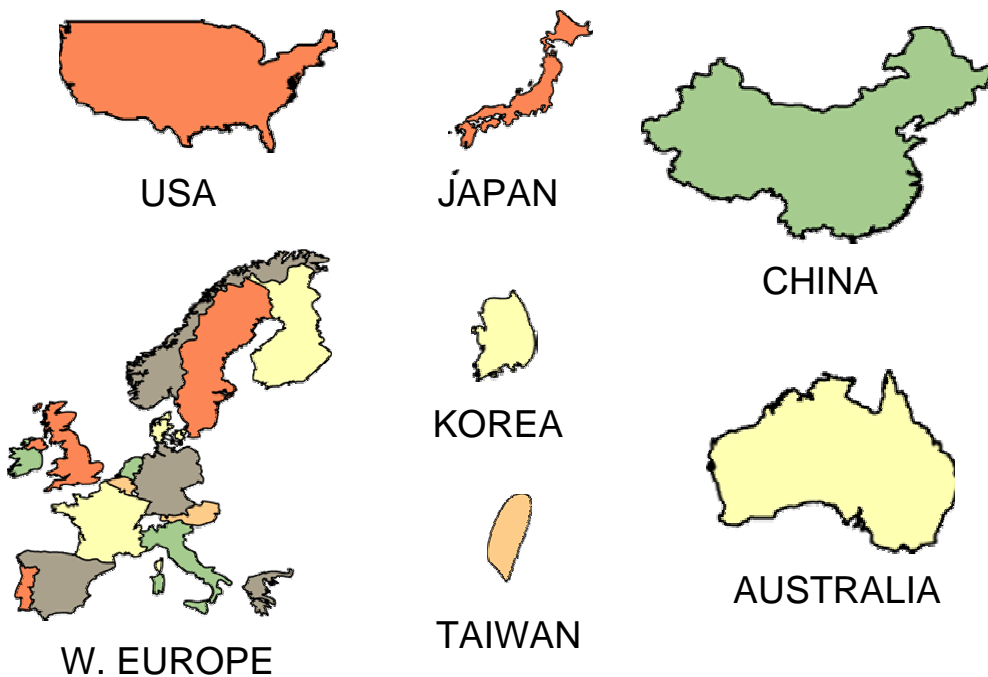**Applications from CDMA
transfer immediately to
WCDMA**

QUALCOMM UMTS TESTING & VERIFICATION PROGRAM

QUALCOMM STATUS TODAY

- **Tested with all 13 WCDMA (UMTS) infra vendors**
- **Test mobiles verified at 2100 MHz & 1900 MHz**
- **GSM/GCF Certified**

Completed testing with operators and infrastructure vendors around the globe

USA

JAPAN

CHINA

KOREA

AUSTRALIA

W. EUROPE

TAIWAN

2002	*First public WCDMA (UMTS) demonstration*
2003	*First public demonstration of consumer WCDMA (UMTS) devices*
2004	*Demonstration of expanded base of consumer devices*

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3GPP Releases and Corrections

Cumulative number of corrections outstanding

Date
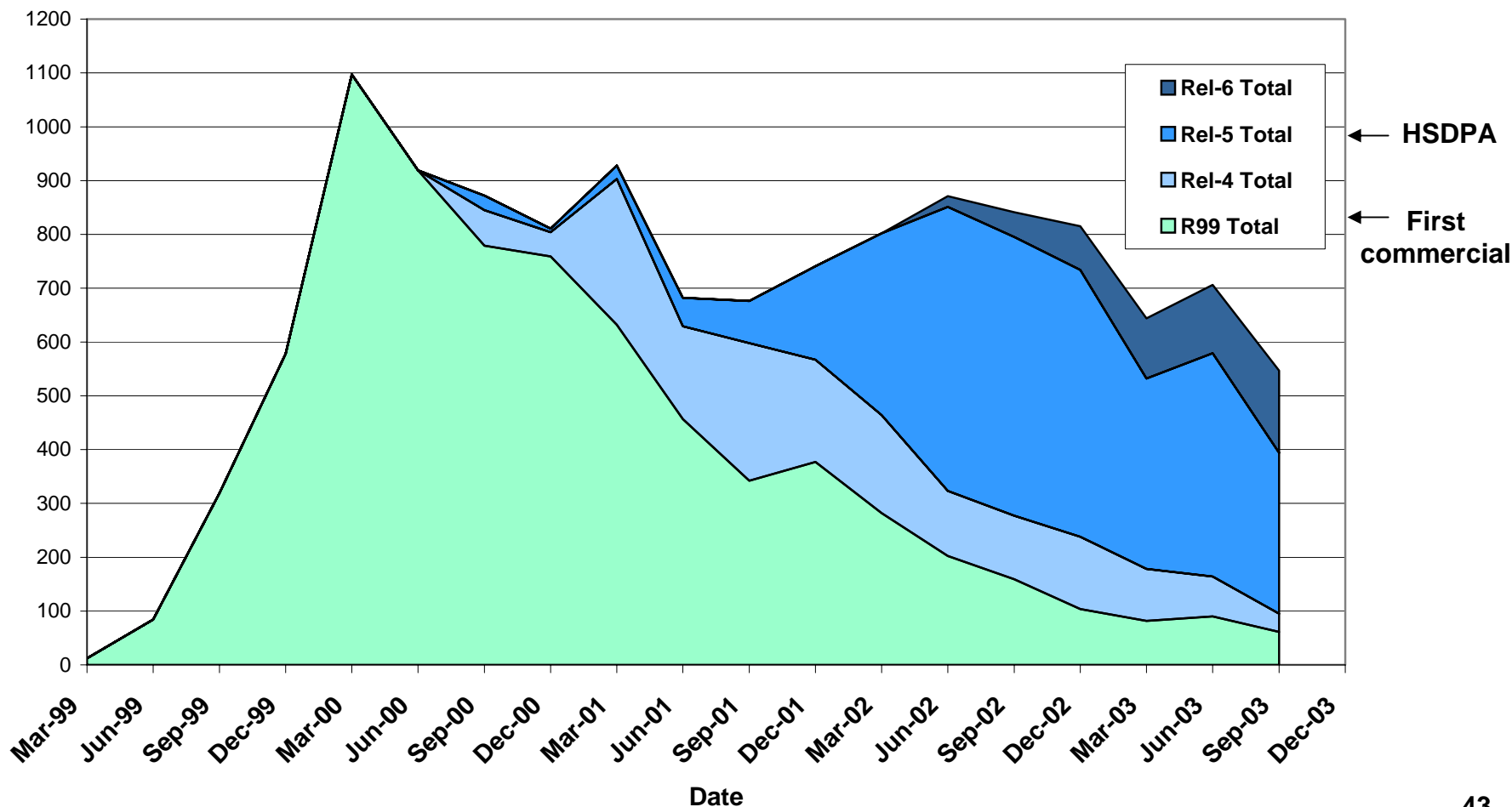
QUALCOMM WCDMA (UMTS) Program Supports Mass Market Devices
New 3G Handset Designs to Support a Variety of Multimedia Features

QUALCOMM WCDMA (UMTS)
selected by 21 manufacturers

QUALCOMM has most
established IOT Program

IOT = interoperability testing

QUALCOMM

WCDMA Handset Evolution - FOMA
Increased Multimedia Experience

Panasonic P2101V (FOMA)
WCDMA
Operator(s) - NTT DoCoMo

Commercially Launched:
October 2001

SPECIFICATIONS
384 kbps data capable,
150 grams,
262,144 color TFT-LCD,
100 min Talktime,
55 hr Standby,
CMOS Camera,
JAVA enabled,
0.8MB data memory

NEC N900i
WCDMA
Operator(s) - NTT DoCoMo

Commercially Launched:
February 2004

SPECIFICATIONS
384 kbps data capable,
115 grams,
2.2-inch, QVGA, 65K color TFT-LCD
External 0.9-inch, 4,096 color STN-LCD,
140 min Talktime
300 hr Standby,
Built-in dual CCD video cameras (outer 2 megapixel)
Avatar-capable videophone
MiniSD card slot
Flash enabled browser (up to 100K)
HTML e-mail
Randomized ringer folder

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WCDMA Handset Evolution - UMTS
Increased Multimedia Experience

NEC e808

UMTS (WCDMA/GSM/GPRS)
Operator(s) - 3 (Hutchison)

Commercially Launched
March 2003

SPECIFICATIONS
384 kbps data capable, **200 grams**, **65,536 color** TFT-LCD (132x162 pixels), Integrated front and back-mounted cameras with 2X zoom, Records and stores 12 second video clips, QWERTY keyboard, 64MB internal memory, **16 Poly ringer** MMS-enabled, MPEG-4 and WMS support, Java-enabled, PIM functions

Samsung SGH-Z105

UMTS (WCDMA/GSM/GPRS)
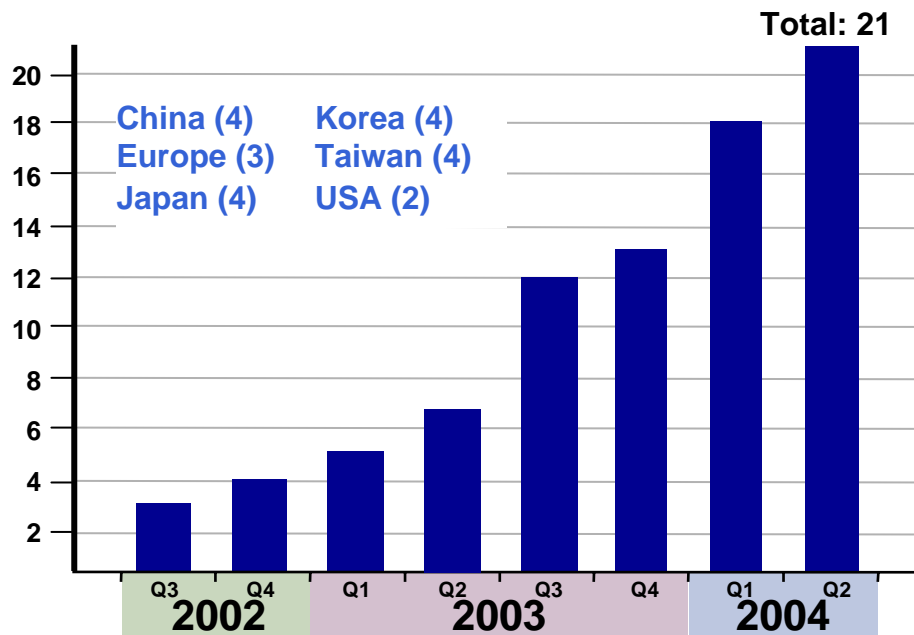Operator(s) – Vodafone

Commercially Launched
May 2004

SPECIFICATIONS
384 kbps data capable, **132 grams**, **260K color** TFT-LCD (176x192 pixel) External, 96x64 pixel, 65K color LCD, 210 min Talktime, 230 hr Standby, Built-in rotating VGA camera, Java, MIDP 2.0 enabled, VOD enabled, MMS14MB, USB cable included, **40 poly ringer**, SyncML

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WCDMA Traction

multimedia Platform | **enhanced** Platform

WCDMA Customers - Cumulative

Total: 21

China (4)   Korea (4)
Europe (3)   Taiwan (4)
Japan (4)   USA (2)

	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2
	2002		**2003**				**2004**	

QUALCOMM 6200 San Diego, CA USA

10 models expected to launch by year-end…

QUALCOMM 6250 San Diego, CA USA

- **QUALCOMM supported commercial launches:**

  vodafone   3   orange

- **QCT-enabled WCDMA devices**

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WCDMA Initiatives

multimedia
Platform

QUALCOMM

enhanced
Platform

QUALCOMM

Immediate Priorities

New Developments

1. **6200 Launches**
    –   **10+ devices**

2. **6250 Launches**
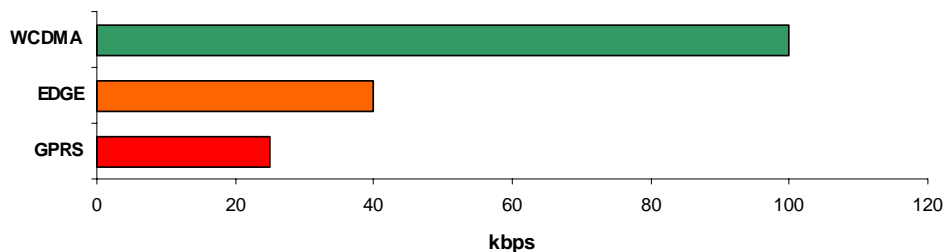   –   **18 customers**
    –   **Apps, modem IOT**

1. **HSDPA**
    –   **6275 @ 1.8 Mbps [Q4 '04]**
    –   **6280 @ 7.2 Mbps [2H '05]**
    –   **RFR/RTR6275: WCDMA/EGPRS radio integration**

2. **Entry-tier**
    –   **6225: speeds WCDMA adoption through greater segmentation**

WCDMA Provides Greater Headroom for 3G Services

Monthly Mbytes/Sub in 5 MHz of spectrum
*Assuming 600 subscribers/sector, 15% busy hour and 25 active days/month

Chart (MB/Month, y-axis 0–100):
- GPRS (red): MMS, SMS — ~6
- EDGE (orange): Web, MMS, SMS — ~18
- WCDMA (green): VOD, MP3, Navigation (w/ maps), Email w/ att., VPN, Web, MMS, SMS — ~90
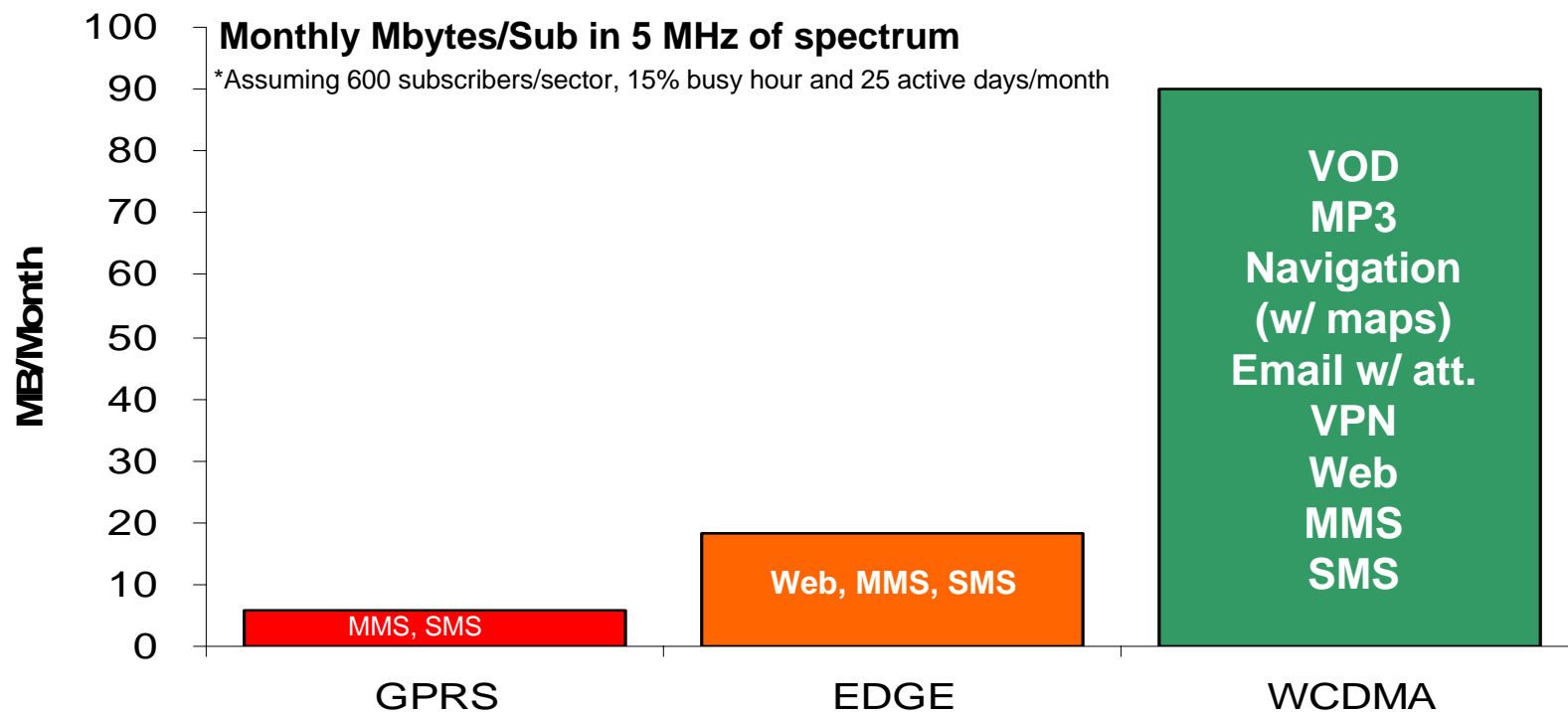
Average User Experience

Bar chart (kbps, x-axis 0–120):
- WCDMA (green): ~100
- EDGE (orange): ~40
- GPRS (red): ~25

kbps

WCDMA Delivers Richer Services